CARLO GAVAZZI

Mobile Equipment

October 2021

SENSORS for MOBILE EQUIPMENT

Customer Requirements

Mobile equipment is one of the most challenging outdoor application ever for a sensor. Any device installed on a vehicle is subject to extreme conditions such as:

- ✓ High level of **shocks and vibrations**
- ✓ **Very low ambient temperature** or **very high operating temperature** due to engines and exhaust systems
- ✓ Supply voltage varies from **less than 10 V to more than 48 V**
- ✓ A sudden battery disconnection from the alternator may generate a **high voltage peak** that would destroy the power supply circuit of the sensor
- ✓ Frequent high pressure and high temperature **cleaning cycles**
- ✓ **Salt** present on the road and **vehicle engine refuses gases** affect the sensor's performance
- ✓ **Electromagnetic interferences** may cause sensor's malfunctioning

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E1-Rating

- In mobile equipment, components must meet the highest quality standards to guarantee **uptime and safe operation on board.** Applications require reliable and accurate detection from inductive sensors.

- **E1 type approval** is a rigorous government certification for mobile equipment that allows operation of a component on public roads and certifies it fully meets the extremely stringent requirements.

ECE 10R-06

SENSORS for MOBILE EQUIPMENT

Applications

Concrete Mixers

Forklifts

Earth-Moving Equipment

Agriculture Equipment

Buses

Garbage Trucks

Mobile Cranes

Fire Trucks

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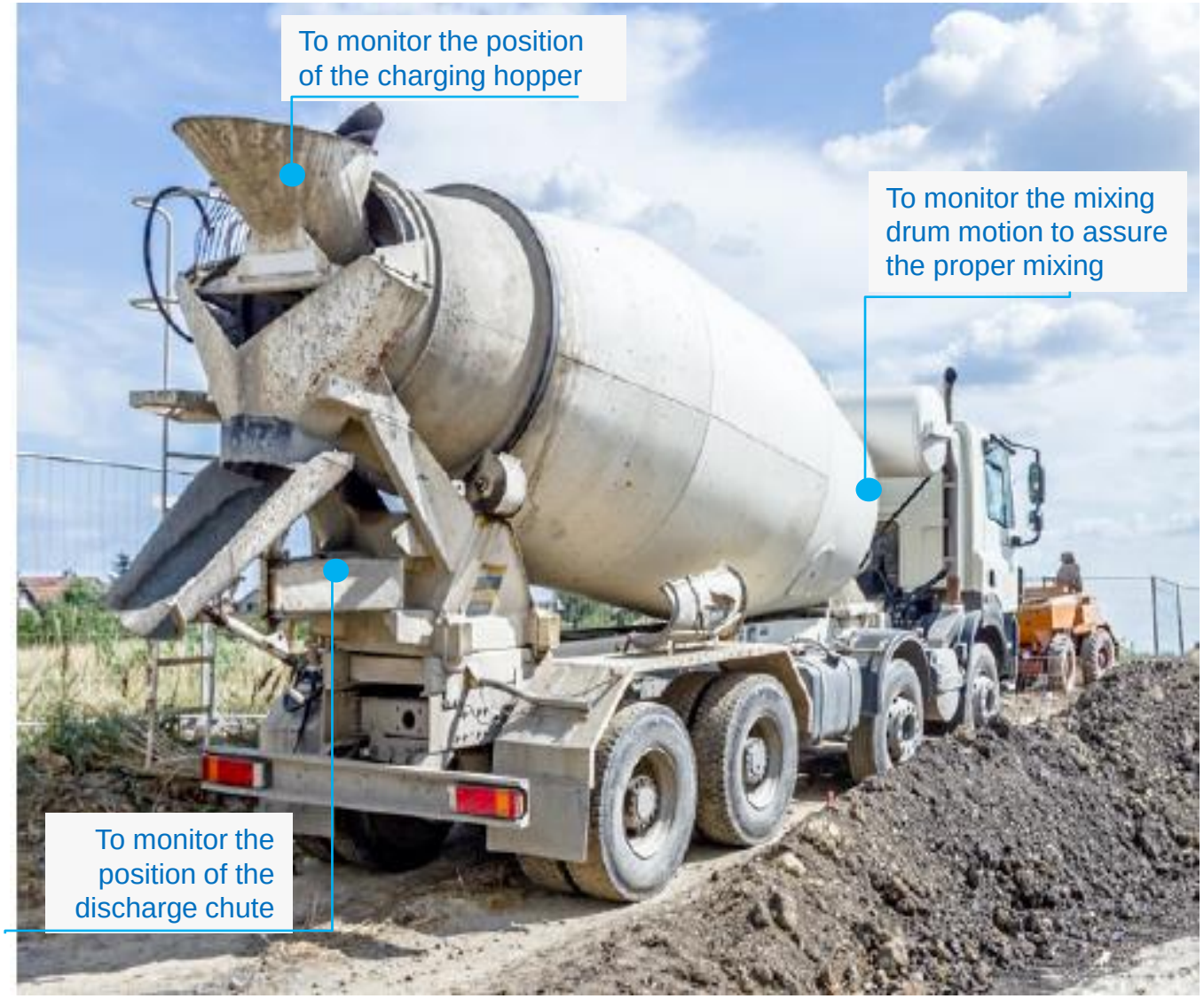
Application Examples – Concrete Mixer Vehicle

CUSTOMER NEED:

Professional drivers of concrete trucks know very well the importance of cleaning their concrete mixing trucks efficiently and safely, so they periodically perform **high pressure and high temperature washdown** to remove **dirt, dust, soils, grease and oils** accumulated during daily operation. During the washing cycles electronic components may stop working due to moisture and water penetration with consequent downtime of the truck



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Application Examples – Construction Equipment

CUSTOMER NEED:

In mobile equipment, the motor and rough terrain cause **vibrations** combined with frequent **shocks** from forceful contact can be challenging for sensors to survive. In these conditions, connections can become loose and corrosion can cause battery disconnection while the AC generator is supplying charging current to the other loads. This can produce **extraordinarily large voltage transients** that would destroy exposed onboard electronics with consequent vehicle downtime.

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Application Examples – Fire Trucks

CUSTOMER NEED:

From everyday incidents to major disasters, in the face of danger, firefighters stand on the front lines no matter the emergency. Efficient communication is critical to their various missions, and they need to do it quickly via a dedicated secure platform for public safety communications. Two-way portable radiotelephone apparatus, like other **radio transmitters**, have the potential to interfere with electronic equipments making them fail with expensive downtime or serious consequences on safety

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Application Examples – Garbage Trucks

CUSTOMER NEED:

Refuse vehicles are required to operate even in **extreme weather** conditions – from the coldest blizzards to the hottest desert combined with heat from the motor or exhaust onboard. A typical environment includes **dirt, sand, dust, debris, oils, and salt**. These challenges would cause a typical sensor to frequently fail.

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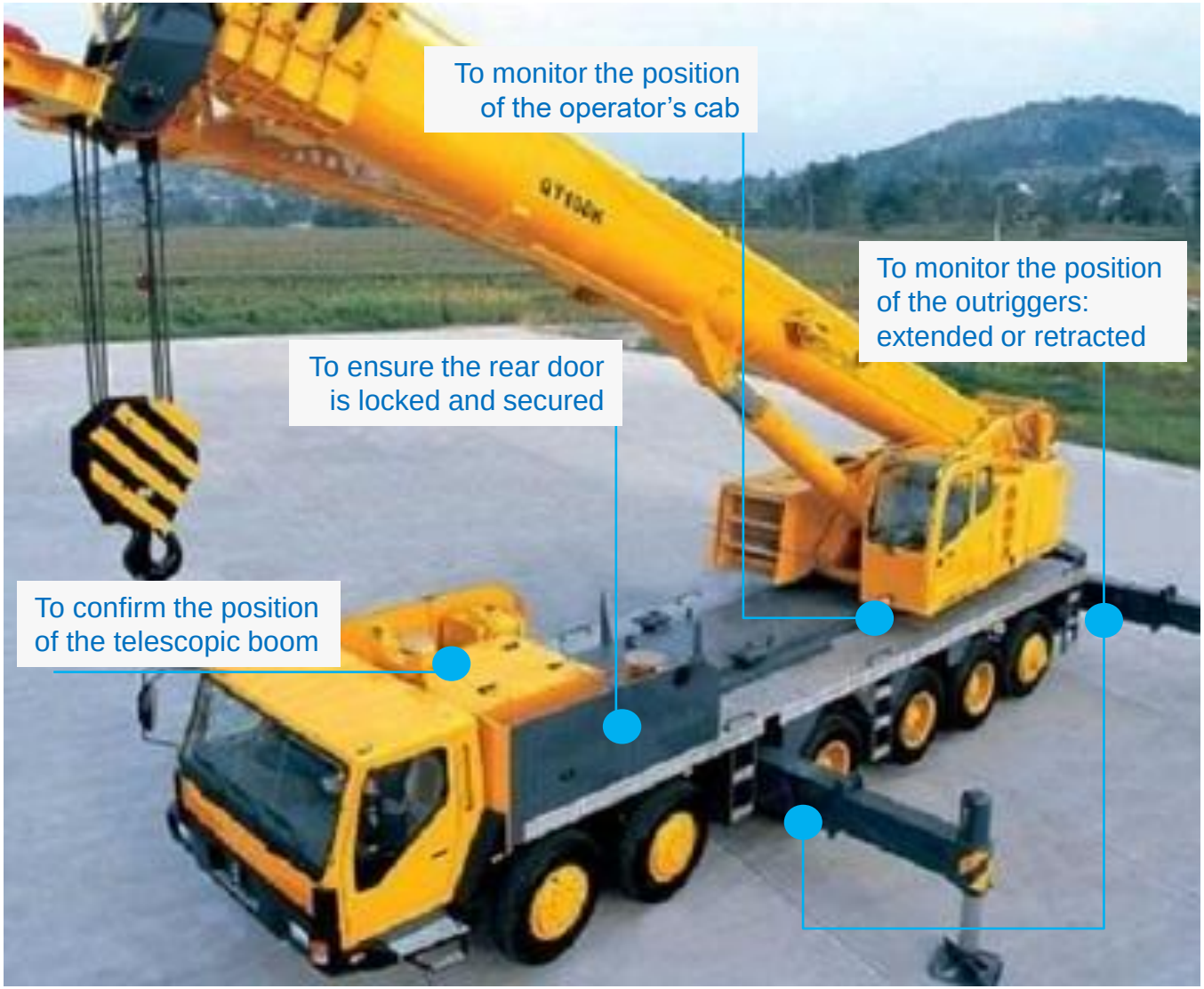
Application Examples – Mobile Cranes

Customer Need:

Mobile cranes, like other mobile equipments, are battery operated. For this reason, the on-board system is generally affected by very high fluctuations: from **voltage sags** when the battery is discharged, to **increased voltage** during charging, and **voltage dips** when higher electrical loads are switched on (e.g., aerial ladders or pumps)



SENSORS for MOBILE EQUIPMENT

Customer Needs

Withstands rough washdown cycles

Protection against large voltage transients, such as load dump

Safe and continuous operation in any battery condition

Immune to false trips from radio transmitters for efficient communication

Protected from surges & bouncing during startup and load interruption

Survives shock, vibration, and exposure to salt, oil, dust, debris

Detection even during extreme environmental conditions & exposures

Reliable & Accurate Detection

Reduced Downtime

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ICS E1 Inductive – Unrivaled Design & Manufacturing

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ELECTRICAL PROTECTION

Protection against large voltage transients, such as load dump

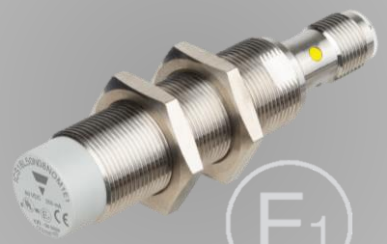
Safe and continuous operation in any battery condition

Immune to false trips from radio transmitters for efficient communication

Protected from surges & bouncing during startup and load interruption

EMC PERFORMANCE

Reliable & Accurate Detection



Reduced Downtime

MECHANICAL DURABILITY

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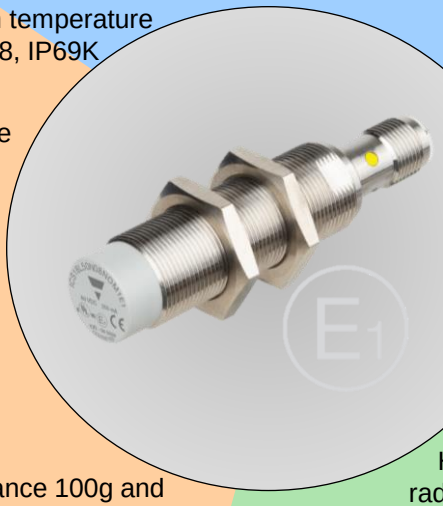
EMC PERFORMANCE



Overload protection

Transients protection

Reverse polarity protection

Short circuit protection

Load-dump protection (ISO 7637-2 / SAEJ1113-11 for 12V and 24V)

High pressure, high temperature washdown IP68, IP69K

Operating voltage 8-60V DC

Operating temperature -40 to +185F

Withstands voltage peaks up to 200V

Salt spray tested (EN 60068-2-52 KB)

Surge mains line to line (EN 61000-4-5)

Stainless steel AISI 304 housing

Power frequency magnetic fields (EN 61000-4-8)

Shock resistance 100g and continuous 40g (EN 60068-2-27 Ea)

High frequency conducted radiofrequency (EN 61000-4-6)

Burst immunity (EN 61000-4-4)

Vibration resistance 20g (EN 60068-2-6)

Electrostatic discharge CD: 8kV / AD: 8kV (EN 61000-4-2)

Radiated noise 200 V/m (ISO 11452-2)

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Additional ICS E1 Features

Custom Connectors

Upon request, preassembled cables and connectors (Deutsch, Packard, Molex, etc.) can be provided to meet every customers' application needs

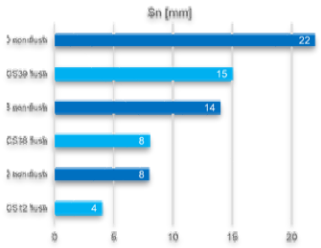
Traceability

Permanently legible laser etched information on the sensor cap

High Switching Frequency

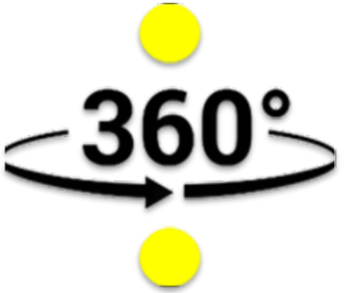
Reliable detection of fast rotating targets

2x Sensing Range

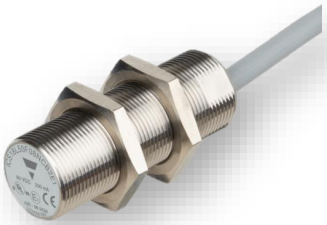


2x standard sensing range allows sensors to be positioned farther away from moving targets and potential damage

User Interface



360 degree LED visibility to quickly understand sensor status: operational, short-circuit protection, overload protection, target detection



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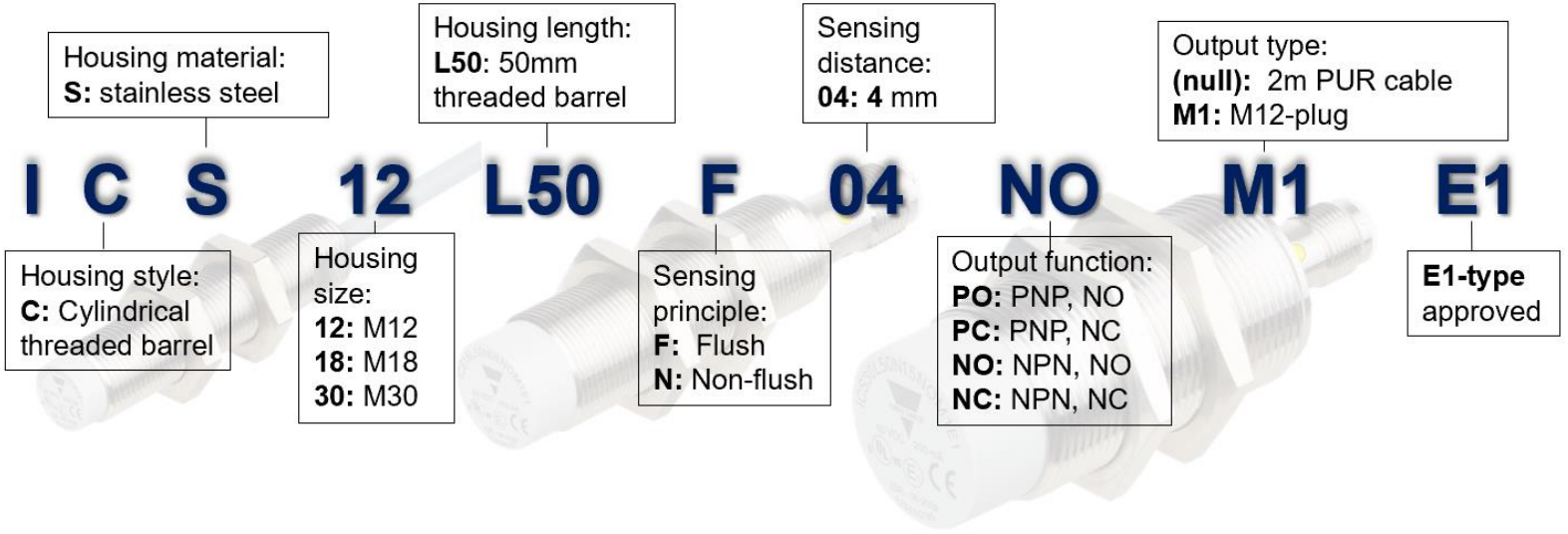
Carlo Gavazzi ICS E1 for Mobile Equipment



Housing	Sn	Mounting	Connection	NPN - NO	PNP - NO	NPN - NC	PNP - NC
M12	4 mm	Flush	Cable	**ICS12L50F04NOB2E1**	**ICS12L50F04POB2E1**	**ICS12L50F04NCB2E1**	**ICS12L50F04PCB2E1**
			Plug	**ICS12L50F04NOM1E1**	**ICS12L50F04POM1E1**	**ICS12L50F04NCM1E1**	**ICS12L50F04PCM1E1**
	8 mm	Non-flush	Cable	**ICS12L50N08NOB2E1**	**ICS12L50N08POB2E1**	**ICS12L50N08NCB2E1**	**ICS12L50N08PCB2E1**
			Plug	**ICS12L50N08NOM1E1**	**ICS12L50N08POM1E1**	**ICS12L50N08NCM1E1**	**ICS12L50N08PCM1E1**
M18	8 mm	Flush	Cable	**ICS18L50F08NOB2E1**	**ICS18L50F08POB2E1**	**ICS18L50F08NCB2E1**	**ICS18L50F08PCB2E1**
			Plug	**ICS18L50F08NOM1E1**	**ICS18L50F08POM1E1**	**ICS18L50F08NCM1E1**	**ICS18L50F08PCM1E1**
	14 mm	Non-flush	Cable	**ICS18L50N14NOB2E1**	**ICS18L50N14POB2E1**	**ICS18L50N14NCB2E1**	**ICS18L50N14PCB2E1**
			Plug	**ICS18L50N14NOM1E1**	**ICS18L50N14POM1E1**	**ICS18L50N14NCM1E1**	**ICS18L50N14PCM1E1**
M30	15 mm	Flush	Cable	**ICS30L50F15NOB2E1**	**ICS30L50F15POB2E1**	**ICS30L50F15NCB2E1**	**ICS30L50F15PCB2E1**
			Plug	**ICS30L50F15NOM1E1**	**ICS30L50F15POM1E1**	**ICS30L50F15NCM1E1**	**ICS30L50F15PCM1E1**
	22 mm	Non-flush	Cable	**ICS30L50N22NOB2E1**	**ICS30L50N22POB2E1**	**ICS30L50N22NCB2E1**	**ICS30L50N22PCB2E1**
			Plug	**ICS30L50N22NOM1E1**	**ICS30L50N22POM1E1**	**ICS30L50N22NCM1E1**	**ICS30L50N22PCM1E1**

Thank you for your attention!

SENSORS for MOBILE EQUIPMENT

Application Challenges

	Application challenge	Sensor solution	Achieved benefits
	In mobile vehicles applications components are stressed by high level of shock and vibrations	Certified **vibration** resistance and continuous shock resistance	Reliable detection of the moving parts in any operating conditions
	Moving parts and mechanical tolerances cause sensors to be hit by the metal target	Extended sensing ranges allow the sensor to be positioned further away from the moving target	Larger installation tolerances and better protection. Longer lifetime and reduced downtime
	Periodic washdown cycles to remove dirt, dust, and oils from the truck can damage sensors	IP69K certifies sealing against high pressure and high temperature washing cycles	Reliable detection even with frequent washdown cycles of the vehicle
	On the road, the presence of corrosive salt chemicals can permanently damage sensors	Robust stainless-steel housings and certified resistance to cyclic salt mist	Vehicle uptime. Longer component lifetime even with the presence of vehicle engine refuses gases

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Application Challenges

	Application challenge	Sensor solution	Achieved benefits
	Exposure to very low and very high temperatures stress the onboard components	Extended operating temperature range	Reliable detection even in harsh winter and when installed next to hot engines and exhaust system
	Batteries are affected by high fluctuations from voltage sags or peaks due to load switching	Wide voltage supply range	Continuous operation and reliable detection with any battery condition
	A battery disconnection from the alternator generates high voltage peaks that damage the sensors	Load dump protection against voltage peaks in the onboard power supply	Increased vehicle up-time due to sensor surviving several potentially destructive pulses
	High electromagnetic interferences due to radio transmitters cause expensive vehicle downtime	Immunity to false actuations when exposed to radiated noise field strength up to 200 V/m	Increased vehicle uptime even during critical applications with presence of radio communications

Sensor Requirements for Mobile Applications

Mechanical Durability

Rough stainless steel housing AISI 304

STAINLESS STEEL 304

IP68 IP69K

Highest ingress protection grade

Vibration resistance 20 g (EN 60068-2-6)

Na+ Cl-

Salt spray (EN 60068-2-52 Kb)

Shock resistance 100 g and continuous 40 g shock (EN 60068-2-27 Ea)

Flush installation - full protection from potential impacts with target

Sensor Requirements for Mobile Applications

Electrical Protection

Extended power supply range **8..60 VDC**

Load-dump protection

Overload protection

Reverse polarity protection

Short circuit protection

Transients protection

Sensor Requirements for Mobile Applications

EMC Performance

Radiated noise (ISO 11452-2) **200 V/m**

0.5 kV Surge mains line to line (EN 61000-4-5)

Burst immunity (EN 61000-4-4) **4 kV**

300 A/m Power frequency magnetic fields (EN 61000-4-8)

Electrostatic discharge (EN 61000-4-2) **ESD**

10 V High frequency conducted radiofrequency (EN 61000-4-6)